AUTOMATION FOR SPECIALTY CROPS

Specialty crops include fruits, vegetables, tree nuts, dried fruits, and nursery plants. Faced with labor shortages, global competition, demand for higher quality, and concern about environmental impacts, the specialty crop industry is urgently seeking automated devices to help with growing, harvesting, handling, and processing.

Researchers at land-grant universities in multiple states are working together to develop automated systems that work well for specialty crops. With this collaborative approach, the cost burden of research and development is lifted from a single specialty crop sector and major advances are being made. Over the last five years, researchers identified key parameters associated with specialty crop production and developed sensors to detect and measure these parameters. Researchers designed mechanized devices and partnered with manufacturers and farmers to commercialize and implement new technologies.

Automation is helping the specialty crop industry overcome labor shortages, make smart management decisions, conserve resources and meet growing demand. These advances are resulting in significant savings for growers and consumers and improved sustainability for the industry.

Automated devices help farmers map fruit yields and see if and where there are issues, so that they can make targeted, effective management decisions. Accurate estimates of yields are also important for marketing decisions. Data about the location of fruits and the geometry of tree branches are used to program machines to harvest orchards.

- **University of Florida** developed an autonomous robot that counts and maps the fruit on citrus trees.
- **University of California-Davis** researchers developed fruit-picking bags and carts with instruments that map orchard fruits.

Automated disease detection and management technologies could mitigate losses of fruit crops.

- Pesticides cause millions of dollars in unintended crop losses when spray droplets drift onto non-target crops. **Iowa State University** work is guiding the manufacturing of technology that reduces drift.
- Citrus growers used a heat treatment machine designed by **University Florida** scientists on more than 80,000 trees to control the progress of citrus greening.
- **Washington State University** developed unmanned aerial vehicles to deter birds that eat and damage fruit crops.
- A low-cost automated quarantine process prevents the spread of coffee berry borer in **Hawaii**, reduces losses, and allows growers to ship coffee to markets in highly populated and tourist areas.
- Handheld devices designed by **University of Hawaii** give coffee growers an inexpensive way to spot leaf water stress. Detecting stress allows growers to optimize irrigation and ensure trees flower at the same time, which makes harvesting more efficient.

Mechanized production and harvesting can prevent injuries due to manual labor and reduce harvest time and costs for farmers.

- 60% of the tomato processing industry has adopted machines designed by **University of California-Davis** to inspect tomato juice. During a single season, the machines eliminate more than 200,000 repetitive motion hazards for workers.
- Farmers said a new pruning method recommended by **Pennsylvania State University Extension** would likely cut pruning time by 42% and save about $136 per acre.

- **Pennsylvania State University** researchers designed a harvest-assist device that eliminated ladder falls and reduced the time apple pickers spent in awkward, dangerous postures from 65% to 43% of picking time. The device also increased the number of apples harvested per second by 50%.
- **Washington State University** scientists designed a robotic twining machine for hops, which will cut labor needs and costs.
- **University of Georgia** researchers explore affordable automated technologies that will improve blueberry harvest efficiency, helping overcome labor shortages and high labor costs.
- Mechanized weeding reduces need for costly manual labor and chemicals, which can harm the environment and human health. **University of Arizona and University of California-Davis** showed that automated in-row weeding machines reduce labor requirements by 30%.

Automation helps farmers conserve resources, save money, and reduce greenhouse gas emissions.

- Using automated dehumidifiers, **Hawaii** coffee and chocolate growers use less energy to dry product.
- **University of Kentucky** researchers demonstrated an autonomous diesel/electric hybrid tractor.
- Researchers discovered that automated robotic weeding systems are effective at much lower power levels than previously considered.

Automated technology helps ensure quality and consumer satisfaction.

- **Michigan State University** and the **University of California-Davis** developed sensing technology capable of detecting internal and external defects, such as color vision and spectroscopy systems that automatically infer fresh produce quality.
- Researchers developed an affordable automated system that accurately identifies mature tomatoes during processing, ensuring products have the superior flavor and lycopene.
- Demand for kava is growing. Researchers designed a mechanized system that extracts 900% more servings of kava per plant.
- Sensor data showed how to breed blueberries that can be machine harvested without being damaged.